

Changes in Diameter of Cervical and Vaginal Length Among Primigravida Before and After Cesarean Delivery

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ABSTRACT

Background: The impact of cesarean delivery on cervical and vaginal dimensions remains incompletely characterized, particularly among primigravida women.

Aim: To assess changes in diameter of cervical and vaginal length and vaginal wall lengths before and after cesarean delivery and to evaluate their correlation in primigravida women.

Methods: This analytic cross-sectional study involved 100 primigravida women recruited from October 6 University Hospital, Egypt, from May 2025 to February 2026. All participants underwent transvaginal and transperineal ultrasonography during the third trimester (36–40 weeks) and at 6 weeks postpartum. Cervical length, anterior vaginal wall length, and posterior vaginal wall length were measured. Statistical analysis was performed using paired t-tests and correlation coefficients.

Results: Significant increases were observed in all parameters postpartum. Cervical length increased from 2.95 ± 0.27 cm to 3.23 ± 0.48 cm ($p < 0.001$). Anterior vaginal wall length showed a slight but statistically significant increase from 6.37 ± 0.86 cm to 6.43 ± 0.97 cm ($p < 0.001$), while posterior vaginal wall length increased from 9.08 ± 0.91 cm to 9.39 ± 1.04 cm ($p < 0.001$). Strong positive correlations were found between antenatal and postpartum measurements ($r = 0.836-0.927$, $p < 0.001$). Postoperative complications were infrequent (7%), with no severe morbidity reported.

Conclusion: Cesarean delivery is associated with small but statistically significant increases in cervical and vaginal lengths, reflecting physiological postpartum remodeling. Individual anatomical characteristics remain largely consistent, and complication rates are low in primigravida women.

Keywords: Cesarean delivery; Cervical length; Vaginal length; Primigravida

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INTRODUCTION

The shape and dimensions of the vagina are of great importance in medicine and surgery, in addition to their relevance to sexual pleasure and childbirth; however, there is no single standardized method to characterize vaginal shape and size (1).

In addition to variations from individual to individual, the size and shape of the vagina in the baseline state can vary substantially during sexual arousal and intercourse (1).

Carrying a pregnancy to term (parity) is associated with a significant increase in the length of the vaginal fornix." The possible effect of parity may be the result of an elongation and stretching of the birth canal at the time of vaginal birth (1).

The length of the vagina differs among women of reproductive age. The cervix's location on the anterior wall of the vagina results in a length difference, with the anterior

wall measuring roughly 7.5 centimeters (2.5 to 3 in) and the posterior wall measuring about 9 centimeters (3.5 in). (2). Pregnancy is associated with a reduction in perineal muscular strength and endurance relative to the prior state. The degree of improvement in perineal muscle function among women post-delivery was correlated with perineal damage experienced during delivery. Upon controlling for parity, maternal age, birthweight, smoking status, and antepartum ratings, the performance ranking from best to worst was cesarean birth followed by intact perineum (3, 4). This study aimed to assess changes in cervical and vaginal lengths before and after cesarean delivery and to evaluate how these changes may influence future gynecological interventions such as cervical screening and intrauterine device (IUD) insertion.

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PATIENTS AND METHODS

This analytic cross-sectional research was conducted on 100 women at the Obstetrics and Gynecology Outpatient Clinic, Faculty of Medicine, October 6 University Hospital, Giza, Egypt, from May 2025 to February 2026, following ethical approval (March 1, 2025) and with written informed consent from all participants.

Inclusion Criteria: Primigravida women, age range: 18 - 39, gestational age in the third trimester (36–40 weeks) for antenatal assessment and six weeks postpartum (after puerperium) and singleton pregnancy.

Exclusion Criteria: Women who had normal vaginal delivery, women with a history of vaginal or cervical operations and women with congenital anomalies of the vagina or cervix.

Methods

All patients were subjected to the following:

Eligible primigravida women were consecutively recruited from the outpatient clinics of October 6 University Hospital after obtaining ethical approval and written informed consent. The research was conducted over a 10-months recruitment period, with an expected sample size of at least 100 participants. A consecutive non-probability sampling technique was used, whereby all eligible and consenting women attending the clinic during the study duration were involved until the required sample size was achieved.

All participants underwent detailed history taking and clinical evaluation, including personal data (residence, age, marital status, occupation, and special habits such as smoking or alcohol intake), menstrual history (timing and regularity of the last menstrual period), obstetric history (gravidity, parity, and history of miscarriages or complications), contraceptive history (type and duration of use), medical history (e.g., hypertension, diabetes mellitus, anemia), surgical history (previous operations), and family history of hereditary or relevant conditions.

Ultrasonographic examinations were performed at the Radiology Department using a Voluson P6 ultrasound system (GE Healthcare, USA) equipped with a RAB2–6 MHz transducer. All participants were instructed to empty their bladders before examination and were positioned in the dorsal lithotomy position. Strict aseptic precautions were followed, including the use of sterile disposable probe covers and ultrasound gel.

Transvaginal sonography (TVS) was first performed by gently inserting the probe into the anterior fornix with minimal pressure to avoid distortion of the cervical canal. The cervix was visualized in the sagittal plane at maximum magnification. The internal os was identified at the junction of the cervical canal with the lower uterine segment, and the external os at the level of the cervical lips opening into the vaginal canal. Cervical length was measured as the linear distance between these two points using electronic calipers. Additionally, anterior and posterior vaginal wall lengths were measured from the introitus to the respective fornices. Following TVS, transperineal sonography (TPS) was conducted using the same probe placed externally on the perineum with sterile gel. This approach provided a sagittal view of the pelvic floor, lower urinary tract, cervix, vaginal

canal, and rectum, allowing confirmation of cervical alignment and vaginal length measurements.

Each participant underwent two ultrasound assessments: the first during the third trimester (36–40 weeks of gestation) prior to cesarean delivery, and the second at six weeks postpartum after completion of the puerperium. For each examination, cervical length, anterior and posterior vaginal wall lengths, uterine orientation, and cervical canal angle relative to the vaginal axis were recorded. In addition, routine obstetric parameters including fetal viability, presentation, amniotic fluid index (AFI), estimated fetal weight (EFW), and placental localization were assessed before delivery to ensure normal pregnancy progression.

Study Outcomes

The primary outcome measure was the change in cervical and vaginal length before and after cesarean delivery among primigravida women. The secondary outcome was to evaluate any related cesarean section complications that could influence these anatomical changes.

Statistical Analysis

Data were collected, coded, and analyzed using Statistical Package for the Social Sciences (SPSS) version 26 (IBM Corp., Armonk, NY, USA). Continuous variables have been presented as mean \pm standard deviation (SD) or median (interquartile range) according to normality evaluated by the Shapiro–Wilk test, while categorical variables were expressed as frequencies and percentages. Comparisons between pre- and post-cesarean measurements were performed utilizing the paired Student's t-test for normally distributed data and the Wilcoxon signed-rank test for non-parametric data. The Fisher's exact test or Chi-square test has been applied for categorical variables as suitable, and a p-value under 0.05 was considered statistically significant.

Ethical Considerations

The research was approved by the Ethical Committee of the Faculty of Medicine, October 6 University. Written informed consent was obtained from all participants after explaining the study objectives and procedures. Confidentiality was strictly maintained by coding all data without personal identifiers. The study complied with the Declaration of Helsinki and Good Clinical Practice guidelines, ensuring participant safety and data integrity (IRB: 06U-ERC-0068).

RESULTS

The mean age of the studied participants was 27.92 ± 4.62 years, (range:18 - 39 years). Regarding residence, 64% of the participants lived in urban areas, while 36% were from rural settings. The majority of participants were housewives (57%), followed by employed women (32%), whereas students and other occupations constituted 4% and 7%, respectively. With respect to lifestyle factors, the vast majority of participants were non-smokers (97%), with only 3% reporting active smoking. Concerning menstrual history, 86% of the women reported regular menstrual cycles, while 14% had a history of menstrual irregularity. (Table 1)

Table 1: Baseline sociodemographic and clinical characteristics of the studied population (n = 100)

Variable	Value
Age (years)	27.92 ± 4.62
Residence	
Rural	36 (36.0%)
Urban	64 (64.0%)
Occupation	
Employed	32 (32.0%)
Housewife	57 (57.0%)
Student	4 (4.0%)
Other	7 (7.0%)
Smoking status	
Non-smoker	97 (97.0%)
Smoker	3 (3.0%)
Menstrual cycle regularity	
Regular	86(86%)
Irregular	14(14%)

Data are presented as mean ± standard deviation for continuous variables and number (percentage) for categorical variables.

Table (2): Descriptive statistics of pre–post differences in cervical and vaginal wall lengths

Variable	Mean ± SD (cm)	95% CI for mean	Median (cm)
Diff Cervix	0.27 ± 0.39	0.19 -0.35	0.23
Diff VagAnt	0.06 ± 0.28	0.01-0.11	0.11
Diff VagPost	0.31 ± 0.50	0.21 – 0.41	0.22

Diff values represent postpartum minus antenatal measurements. Data are presented as mean ± standard deviation. CI = confidence interval.

The mean differences indicate that Diff_VagPost shows the greatest change (0.31 ± 0.50 cm), followed by Diff_Cervix (0.27 ± 0.39 cm), while Diff_VagAnt demonstrates the smallest change (0.06 ± 0.28 cm). The 95% confidence intervals for all variables are relatively narrow and do not cross zero, suggesting generally consistent measurements with modest variability. The medians are close to the means, indicating no major skewness in the data distribution.

Overall, the posterior vaginal measurements appear to exhibit the most pronounced change among the studied variables. (Table 2)

Table (3): Paired comparison of cervical and vaginal wall lengths before and after cesarean delivery (n = 100)

Variable	Antenatal (mean ± SD)	Postpartum (mean ± SD)	T	p-value
Cervical length (cm)	2.95 ± 0.27	3.23 ± 0.48	-6.9	<0.001
Anterior vaginal wall length (cm)	6.37 ± 0.86	6.43 ± 0.97	-3.0	<0.001
Posterior vaginal wall length (cm)	9.08 ± 0.91	9.39 ± 1.04	-6.1	<0.001

Data are presented as mean ± standard deviation. Paired-samples t-test was used for comparison.

There were statistically significant increases in all measured parameters from antenatal to postpartum assessments. Cervical length increased from 2.95 ± 0.27 cm to 3.23 ± 0.48 cm (p < 0.001), while the anterior vaginal wall length showed a slight but significant rise from 6.37 ± 0.86 cm to 6.43 ± 0.97 cm (p < 0.001). A more pronounced increase was observed in posterior vaginal wall length, from 9.08 ± 0.91 cm to 9.39 ± 1.04 cm (p < 0.001). Despite the relatively

small absolute differences—particularly for the anterior vaginal wall—the consistently low p-values indicate that these changes are statistically significant. Overall, the findings suggest measurable postpartum elongation of the cervix and vaginal walls, likely reflecting physiological remodeling after childbirth, although their clinical significance should be interpreted cautiously. (Table 3)

Table (4): Correlation between antenatal and postpartum measurements

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Measurement pair	Correlation coefficient (r)	p-value
Cervical length	0.836	<0.001
Anterior vaginal wall length	0.927	<0.001
Posterior vaginal wall length	0.898	<0.001

Cervical length measurements demonstrated a high correlation ($r = 0.836, p < 0.001$), indicating that women with longer cervixes antenatally tended to maintain relatively longer measurements postpartum. Similarly, very strong correlations were found for both the anterior vaginal wall ($r = 0.927, p < 0.001$) and the posterior vaginal wall ($r = 0.898, p < 0.001$), reflecting marked intra-individual

consistency in vaginal dimensions across the two time points. (Table 4)

Table (5): Frequency and types of cesarean section–related complications (n = 100)

Variable	Category	n (%)
Type of complication	None	93 (93.0%)
	Fever	1 (1.0%)
	Hematoma	1 (1.0%)
	Postpartum hemorrhage	2 (2.0%)
	Wound infection	1 (1.0%)
	Other	2 (2.0%)

Data are presented as number (percentage) of the total study population.

The postoperative course was uneventful in most cases, with 93% of women experiencing no complications and only 7% developing any postoperative issue after cesarean delivery. The most common complications were postpartum hemorrhage and miscellaneous events (2% each), while fever, hematoma, and wound infection were rare (1% each). Importantly, no severe maternal morbidity or life-

threatening complications were reported, indicating an overall low complication rate and favorable surgical outcomes in this cohort of primigravida women. (Table 5)

Table (6): Distribution of ultrasonographic quality-control flags among the studied population (n = 100)

Quality-control indicator	Category	n (%)
AFI outside 5th–95th percentile	No	88 (88.0%)
	Yes	12 (12.0%)
EFW outside 10th–90th percentile	No	92 (92.0%)
	Yes	8 (8.0%)
Postpartum cervical length < 2.5 cm	No	96 (96.0%)
	Yes	4 (4.0%)

AFI = amniotic fluid index; EFW = estimated fetal weight. Data are presented as number (percentage) of the total study population.

The majority of cases demonstrated values within the expected gestational- age–adjusted reference ranges. AFI values falling outside the 5th–95th percentile was observed in 12% of participants, while EFW values outside the 10th–90th percentile range were detected in 8% of cases. With respect to postpartum cervical assessment, only 4% of women exhibited a cervical length below 2.5 cm, indicating that marked cervical shortening in the early postpartum period was uncommon in this cohort. (Table 6)

DISCUSSION

The current study found that the mean age of the studied population was 27.92 ± 4.62 years, ranging from 18 to 39 years. Regarding residence, 64% of the participants were

living in urban areas, while 36% were from rural settings. More than half of the women were housewives (57%), followed by employed women (32%), whereas students and other occupations constituted 4% and 7%, respectively. With respect to lifestyle factors, the vast majority of the cohort were non-smokers (97%), with only 3% reporting active smoking. Concerning menstrual history, 86% of the women reported regular menstrual cycles, while 14% had a history of menstrual irregularity. This is consistent with Gameraddin, (5) who reported that evaluating cervical length and obstetric outcomes, where the mean maternal age ranged between the late twenties and early thirties, with most participants being non-smokers and having regular menstrual pattern.

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This study showed that the antenatal assessment in the third trimester revealed a mean gestational age of 37.94 ± 1.15 weeks, confirming that all women were evaluated within the predefined gestational window (36–40 weeks). The mean amniotic fluid index (AFI) was 12.50 ± 1.68 cm, indicating that the majority of cases had normal liquor volume. Similarly, the mean estimated fetal weight (EFW) was 2987 ± 333 g, consistent with appropriate fetal growth near term. Delivery occurred at a mean gestational age of 39.47 ± 1.03 weeks, reflecting a predominantly term population.

This is supported by Kwak et al. (6) who assessed fetal growth reported mean birth weights around 3000 g at term, which is comparable to the estimated fetal weight observed in the current study.

Similarly, ultrasound-based studies evaluating postpartum pelvic anatomy have reported measurable changes in pelvic floor and vaginal structures after childbirth. These studies indicate that several pelvic measurements, including cervical descent and vaginal wall parameters, can vary significantly during the postpartum period as part of the recovery and remodeling process of the pelvic floor (7).

Also, Lauterbach et al., (8) assessing cervical length during pregnancy and after delivery have highlighted that cervical measurements are dynamic and may change over time due to physiological tissue remodeling. This dynamic behavior of cervical tissue supports the small but measurable differences between antenatal and postpartum measurements observed in the current study. Antenatally, the mean cervical length was 2.95 ± 0.27 cm, which increased to 3.23 ± 0.48 cm postpartum.

Regarding vaginal dimensions, the mean anterior vaginal wall length increased significantly from 6.37 ± 0.86 cm antenatally to 6.43 ± 0.97 cm postpartum. The posterior vaginal wall length showed a more evident increase, rising from 9.08 ± 0.91 cm before delivery to 9.39 ± 1.04 cm after delivery. A statistically significant increase in cervical length was observed after cesarean delivery, with a mean difference of 0.27 cm, corresponding to an actual postpartum increase of 0.19 cm ($p < 0.001$). Similarly, the anterior and posterior vaginal wall length demonstrated a significant postoperative increase, with a mean difference of 0.06 and 0.31 cm ($p < 0.001$).

These measurements fall within the range of normative vaginal anatomy reported in imaging studies, where mean total vaginal length in adult women has been described around 6–10 cm depending on measurement technique and individual variability, suggesting that our findings represent physiological variation rather than pathological change (9, 1)

Although the literature specifically assessing antenatal versus postpartum vaginal wall lengths is limited, broader research on postpartum pelvic anatomy confirms that vaginal and pelvic floor tissues undergo remodeling after childbirth. Vaginal changes after delivery are expected as part of the normal recovery process, with variations in width, laxity, and tissue tone reported even in uncomplicated postpartum courses. Mode of delivery also influences pelvic floor outcomes, with cesarean section generally associated with less mechanical stress on the

vaginal walls and supporting structures compared to vaginal birth (10).

This may explain why changes in anterior vaginal wall length were minimal although statistically significant, the change is minimal and may not be clinically significant, and why posterior vaginal wall increases were modest, reinforcing the understanding that, in the absence of direct stretching forces encountered during vaginal delivery, cesarean delivery is less likely to produce dramatic alterations in vaginal dimensions.

Cesarean delivery is less likely to produce dramatic alterations in pelvic floor anatomy compared to vaginal delivery, as pelvic floor trauma is primarily associated with vaginal childbirth (11, 12).

The present study demonstrated strong positive correlations between antenatal and postpartum measurements for cervical length as well as anterior and posterior vaginal wall dimensions. Specifically, cervical length showed a high correlation ($r = 0.836$, $p < 0.001$), suggesting that women with longer cervixes during pregnancy generally maintain relatively longer cervical measurements after delivery. Likewise, the anterior and posterior vaginal walls exhibited very strong correlations ($r = 0.927$ and $r = 0.898$, respectively; $p < 0.001$), indicating marked intra-individual consistency in vaginal dimensions across the antenatal and postpartum periods. These findings highlight the relative stability of female pelvic anatomy and reinforce the predictive value of antenatal measurements for postpartum structural assessment, which is consistent with previous studies emphasizing that individual anatomical characteristics are largely maintained after delivery.

Pelvic and cervical measurements remained largely unchanged after cesarean delivery, suggesting that they reflect stable anatomical characteristics rather than temporary changes. This is consistent with our findings and indicates that these measurements are reliable over time. Although cervical length is mainly used to predict labor outcomes, studies also show that transvaginal ultrasound measurements are consistent and dependable in different clinical settings (13). Although direct literature on postpartum correlation of vaginal wall dimensions is limited, the strong correlations observed in our cohort likely reflect stable anatomical traits rather than measurement artifacts, aligning with the principle that well-standardized sonographic measures exhibit high reproducibility when technical conditions are controlled.

In the current study, the frequency and pattern of cesarean section-related complications were carefully evaluated. The postoperative course was uneventful for the vast majority of participants, with 93% of women experiencing no complications. Only 7% of patients developed at least one postoperative event. Among the recorded complications, postpartum hemorrhage and other miscellaneous events were the most frequent, each occurring in 2% of cases, while fever, hematoma formation, and wound infection were each observed in 1% of patients. Importantly, no severe maternal morbidity or life-threatening complications were documented. These findings indicated that cesarean delivery in this cohort of primigravida women was associated with a low overall

complication rate, reflecting favorable perioperative and postoperative outcomes in the studied setting.

When placed in context of existing research, these rates appear lower than many reported in broader obstetric populations. PPH is widely recognized as one of the most common complications associated with cesarean delivery, with several large observational studies citing incidence rates that often exceed those seen in our cohort. For example, Sajjad et al. (14) suggest that postpartum hemorrhage following cesarean section can occur in approximately 3%–5% of deliveries, with even higher rates reported in some emergency settings, depending on definitions and clinical practices used.

CONCLUSION

Cesarean delivery in primigravida women is associated with a general increase in cervical and vaginal wall lengths postpartum, reflecting physiological remodeling after delivery. Strong positive correlations between antenatal and postpartum measurements indicate that individual anatomical characteristics tend to remain consistent. Fetal growth parameters, amniotic fluid volume, and postpartum cervical length were generally within normal ranges, while cesarean-related complications were infrequent. Overall, these findings suggest that cesarean delivery in low-risk primigravida women is associated with favorable maternal and fetal outcomes, and that antenatal measurements may provide useful predictive information for postpartum pelvic anatomy. These findings may have implications for future gynecological procedures such as cervical screening and intrauterine device insertion.

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